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For illustration, a complete quaternary cubic in normal order is the following:

$$\begin{aligned} & x_1^3 + x_1^2x_2 + x_1x_2^2 + x_2^3 + x_1^2x_3 + x_1x_2x_3 + x_2^2x_3 \\ & + x_1x_3^2 + x_2x_3^2 + x_3^3 + x_1^2x_4 + x_1x_2x_4 + x_2^2x_4 + x_1x_3x_4 \\ & + x_2x_3x_4 + x_3^2x_4 + x_1x_4^2 + x_2x_4^2 + x_3x_4^2 + x_4^3. \end{aligned}$$

The number of terms between  $x_1^2x_3$  and  $x_3x_4^2$  is

$$N\left(\begin{array}{cccc} 2 & 0 & 1 & 0 \\ 0 & 0 & 1 & 2 \end{array}\right) = \left\{ \begin{array}{l} \left(\begin{array}{c} 0 \\ 0 \end{array}\right) + \left(\begin{array}{c} 1 \\ 0 \end{array}\right) \\ + \left(\begin{array}{c} 1 \\ 1 \end{array}\right) + \left(\begin{array}{c} 2 \\ 1 \end{array}\right) \\ + \left(\begin{array}{c} 3 \\ 2 \end{array}\right) + \left(\begin{array}{c} 4 \\ 2 \end{array}\right) \end{array} \right\} = 14.$$

The total number of terms in a complete ternary form of order  $m$  is

$$1 + N\left(\begin{array}{ccc} m & 0 & 0 \\ 0 & 0 & m \end{array}\right) = \left\{ \begin{array}{l} \left(\begin{array}{c} 0 \\ 0 \end{array}\right) + \left(\begin{array}{c} 1 \\ 0 \end{array}\right) + \cdots + \left(\begin{array}{c} m-1 \\ 0 \end{array}\right) \\ + \left(\begin{array}{c} 1 \\ 1 \end{array}\right) + \left(\begin{array}{c} 2 \\ 1 \end{array}\right) + \cdots + \left(\begin{array}{c} m \\ 1 \end{array}\right) \end{array} \right\} + 1 = \frac{1}{2}(m+1)(m+2).$$

EXERCISE. Show that the number of terms between  $x_1^3x_2^2x_3^2x_4^{m-7}$  and  $x_1^2x_2x_3^2x_4^{m-5}$  in a complete ordered quaternary polynomial of order  $m$  ( $m > 6$ ) is 59.

EXERCISE. Show that

$$N\left(\begin{array}{cccc} 1 & 1 & 2 & 1 \\ 2 & 1 & 1 & 0 \end{array}\right) = 31.$$

## NOTES AND NEWS.

SEND COMMUNICATIONS TO D. A. ROTHROCK, Indiana University.

Dr. OTTO DUNKEL, formerly instructor at the University of Missouri, has been appointed assistant professor of mathematics at Washington University, St. Louis, Mo.

"Differential equations and implicit functions in infinitely many variables" is the title of a paper by Dr. W. L. HART of Harvard University, abstract of which appeared in the *Proceedings* of the National Academy of Sciences for June, 1916.

Mr. EDWARD B. ESCOTT is now connected with the auditing department of the Kansas City Life Insurance Company, Kansas City, Mo.

Mr. H. C. CLEVINGER, of Urbana, Ill., has accepted an instructorship in mathematics at the University of Minnesota.

Dr. R. L. BÖRGER, associate in mathematics at the University of Illinois, goes to Ohio University at Athens as professor of mathematics.

Dean THOMAS F. HOLGATE, professor of mathematics at Northwestern University, has been chosen by the trustees *ad interim* president of the University.

The *Washington University Studies*, January, 1916, contains a paper by Professor W. H. ROEVER on "Some recent work on the problem of the deviations of freely falling bodies." This paper is a sixteen-page résumé of the publications of ROEVER, CAJORI, HALL, WOODWARD, MOULTON, and others, which have appeared in *Science*, *Bulletin and Transactions of the American Mathematical Society*, the *Astronomical Journal*, *Physical Review* and other periodicals.

An expository volume on integral equations appeared in July, 1916, with the title *Elementi della Teoria delle Equazioni Integrali Lineari* by G. VIVANTI. The book appears in the extensive collection called, *Manuali Hoepli*, and contains about four hundred pages. In the preface the author refers to the present European war and to the need of scientific emancipation of Italy. The present volume is a contribution in that direction.

*The Philosophical Transactions of the Royal Society of London*, Vol. 216, 1916, has a paper by K. PEARSON, the noted biometrician, on "Mathematical contributions to the theory of evolution."

The July, 1916, number of *The Mathematical Gazette* contains the concluding article by E. H. NEVILLE, on "So-called cases of failure in the solution of linear differential equations" referred to in the October issue of the MONTHLY. The introductory part of this discussion appeared in the May issue of the *Gazette*.

The first number of Vol. 18 of *The Annals of Mathematics* has appeared containing the following papers: "On a surface of lowest degree passing through a given curve in space," by T. HYASHI; "A practical method of determining elementary divisors," by H. T. BURGESS; "Conjugate systems with equal point invariants," by L. P. EISENHART; "On the derivative of a function at a point," by J. F. RITT; "An existence theorem for the solution of a type of real mixed difference equations," by A. A. BENNETT; "Double elliptic geometry in terms of point and order alone," by J. R. KLINE; "An application of a group of order sixteen to a configuration of an elliptic cubic," by A. EMICH.

Parts II and III, of Vol. 40, *Rendiconti del Circolo Matematico di Palermo*, contain fourteen research papers among which are the following in English: "A new theorem in analytic conics," by A. HAWKESWORTH; "The meaning of Plücker's equations for a real curve," by J. L. COOLIDGE; "On Stieltjes's integral," by T. HAYASHI; "Plane nets periodic of period three under the Laplacian transformation," by J. O. HASSLER.

MISS ELEANORA HARRIS, head of the department of mathematics at the Hutchinson, Kan., high school, and secretary of the Kansas Association of Mathematics Teachers, has been markedly successful in conducting a mathematics club for the advanced students in the high school. They have discussed

the practical uses of graphs, of the slide rule, and of determinants of the second and third orders. They have studied the history of our numerals, of logarithms, and of the Pythagorean theorem. And they have debated the question whether one year of algebra and one year of geometry should not be required of all students for graduation from the high school.

The fourth annual meeting of the Mathematics Section of the California High School Teachers' Association was held in July at the University of California under the chairmanship of Professor HENRY W. STAGER, Fresno Junior College. The following program was presented: "Non-technical discussion of some questions of general interest in geometry," by Professor E. J. WILCZYNSKI, University of Chicago; "Mathematics as an applied subject," by Dr. E. R. SNYDER, California Commissioner of industrial and vocational education; "Minimum requirements in mathematics," by Professor HENRY W. STAGER, Fresno Junior College; "Some of the difficulties a mathematics teacher of to-day must face," by FRANK R. MORRIS, Glendale High School. The discussions centered largely upon the present attacks upon the teaching of mathematics in the secondary schools by the leaders of the vocational movement. It was urged that united effort be made to meet these attacks and that all teachers of mathematics as individuals and in organizations should continue to defend the cultural value of mathematics.

In order to make the work of the Section more continuous and more effective, a standing committee on policy, selected from all parts of the state, was authorized. An educational survey of the teaching of mathematics in California was also authorized, the survey to be undertaken by the committee on policy in coöperation with the State Commissioner for secondary schools. The official reading course for the past year as printed in the MONTHLY for March, 1916, pp. 77-78, was adopted for the year 1916-1917 without change. Professor C. A. NOBLE, University of California, was elected chairman of the Section, and Mr. G. E. MERCER, Palo Alto High School, secretary for the ensuing year.

The Association of Mathematics Teachers of New Jersey is the second, so far as we know, the California association being the first, to organize with the distinct purpose of giving to high school teachers the "upward look"; or, to use the words of one of the organizers of the New Jersey society, to choose as the field of activity what may be called "graduate work in high school mathematics." To this end, each program has papers emphasizing the "graduate," or in other words, the "collegiate" point of view. For instance, at one of their earlier meetings, Professor OSWALD VEBLER, of Princeton University, gave a paper on "The affine geometry"; Professor RICHARD MORRIS, of Rutgers College, spoke on "The auxiliary angle"; Professor C. O. GUNTHER, of Stevens Institute of Technology, on "Trigonometry for the college student"; and Mr. HARRISON E. WEBB, of the Central High School of Newark, on "Geometric definitions of the trigonometric functions." Their subsequent programs have continued to include papers of this character.

Professor H. W. Tyler contributes the following biographical note:

"Professor WEBSTER WELLS, long a member of the Faculty of the Massachusetts Institute of Technology, died in a private hospital near Boston, May 23, 1916. Born in 1851, Professor Wells prepared for the Institute at the Allen School, West Newton, Massachusetts. He was graduated in civil engineering in 1873 and was then appointed instructor in mathematics. In 1880 he went to Germany for further study, spending two years in Leipsic, mainly in private mathematical work. Returning to the Institute in 1882, he continued teaching until his retirement on account of serious impairment of health in 1911. At the time of his return from Germany conditions were not yet favorable for the introduction of advanced or graduate courses, and Professor Wells accordingly devoted his unusual powers of lucid exposition to the preparation and publication of an extended series of text books in the whole field of elementary mathematics. These texts represent an enormous amount of careful labor in a field already so long cultivated. They are in general notable for the clear and skilful arrangement of traditional materials rather than for any attempt at innovations. Professor Wells was a member of the American Mathematical Society since 1895.

Outside of the field of mathematics, Professor Wells was especially interested in music and foreign travel; also early in life in mountaineering. He was for a short time Secretary of the Faculty, and Bursar of the Institute.

#### NOTES ON THE ASSOCIATION.

The first annual meeting of the Association will take place on Friday and Saturday, December 29, 30, 1916, at Columbia University, New York City. The selection of the place of meeting was determined by the fact that the American Association for the Advancement of Science meets in New York during holiday week, thus bringing together large numbers representing most of the national scientific societies of the country. In particular, the American Mathematical Society will hold its annual meeting at Columbia University on Wednesday and Thursday, December 27, 28, so that the juxtaposition of dates for the Association and the Society will make it convenient for mathematicians to attend both meetings.

The program of the annual meeting of the Association will be in charge of a committee consisting of Professor D. E. Smith of Columbia University, Chairman, Professor E. H. Moore of the University of Chicago, and Professor G. D. Olds of Amherst College. A special sub-committee consisting of Professor J. N. Van der Vries of the University of Kansas, Chairman, Professor J. N. Hart of the University of Maine, and Professor Helen Merrill of Wellesley College, will arrange the program for the meeting of institutional delegates.

The committee on arrangements for the New York meeting consists of Professor T. S. Fiske of Columbia University, Chairman, Professor T. W. Edmondson of New York University, Professor Paul Saurel of the College of the City of New York, Professor Emma Requa of Hunter College, and Professor D. E. Smith of Teachers College. All these committees are authorized to extend

their membership as circumstances may dictate. They will issue preliminary reports as early as seems feasible. It is hoped that the December issue of the MONTHLY may contain a full outline of the programs and arrangements.

Another important committee of the Association has just been organized, namely, the Library Committee which was authorized last spring and consists of the following persons: Professor W. B. Ford (Chairman), University of Michigan; Professor S. Lefschetz, University of Kansas; Professor W. R. Longley, Yale University, and Professor R. E. Root, U. S. Naval Academy. This committee is already considering plans for its operation and will make a public statement through the columns of the MONTHLY within a short time. In general, it may be said that the Association proposes to take a lively interest in the development of mathematical libraries in the colleges and will wield its influence as far as possible toward this end.

At about the time when this issue of the MONTHLY reaches the members of the Association, the nomination ballots will be received from the Secretary, and the first opportunity will be presented for selecting candidates for the officers of the Association by open primaries. This provision of the Constitution is in the nature of an experiment and its successful operation depends entirely upon the thoughtful interest shown by each member. The nominations will close on November 20 and hence prompt action is needed in returning the ballots.

Four sections of the Association have thus far been organized, namely, in Kansas, Ohio, Missouri, and Iowa. Aside from the organization meetings, the Ohio and Kansas sections have each held meetings in which successful programs were carried out. The Missouri Section will conduct its first program on Saturday, November 16, 1916, at St. Louis, Missouri, and the Iowa Section is likewise planning to hold a meeting soon. It seems clear that the gatherings in which the great body of the membership can take part must be in the smaller geographical units rather than in the national meetings. Gratifying as was the attendance at the Cambridge meeting, and gratifying as the still larger attendance at New York is almost certain to be, nevertheless, these national meetings can probably never include more than one tenth to one fifth of the membership. Hence, whatever benefit is to come from attendance upon meetings and mingling with other members must, for the large majority, be found in the sectional meetings.

It should be possible for almost any member to reach some central meeting place within his own state at least once each year. Moreover, the opportunities afforded in the smaller groups for more extended discussions, especially upon those questions which involve local conditions as, for instance, legislation by states on educational matters, should be such as to attract all members of a section and to command their active participation in shaping the development of mathematical interests in their communities.

It is, therefore, confidently expected that, as time goes on, the Association will develop this phase of its activities very strongly and that numerous other sections will be organized in the near future. Already it is reported that steps

are being taken in this direction in at least three other centers, and doubtless the matter is under informal consideration in still other parts of the country. There is no need for haste, but there is need for most careful deliberation in order that any action that is taken may be permanent and effective. A watch-word that may well be considered as indicative of the spirit of this Association is "active participation on the part of all members." It is a fact of more than ordinary significance that already well toward one hundred persons are directly engaged in active service either as members of the Council, as members of the Editorial Board, or as members of standing or special committees. Indeed, if we count the officers and committees of sections already formed and in process of formation, and the contributors to the programs of meetings and to the various departments of the MONTHLY, the number of active workers must be considerably over one hundred. While this may be considered a most favorable beginning for the first year, nevertheless, the ultimate goal should be to enlist at least one thousand active participants in the affairs of the Association. This can be done as soon as the sections are numerous enough to enable every member to attend at least one meeting a year, and as soon as the opportunities for co-operation in connection with the publications of the Association and in connection with the investigations of its standing committees are fully realized. The great work of this Association will doubtless be done through its sectional meetings, where personal contact and individual responsibility will have full play, through its standing committees which in time are sure to influence every phase of mathematical interests in the country, and through its official publications which should become the clearing-house for all these activities and the medium of intercommunication which will keep every member, however remote from the natural geographical centers, in close touch with all that is taking place in the mathematical world.

One most effective service which any member may render at once is to make known to those who are as yet out of touch with the MATHEMATICAL ASSOCIATION OF AMERICA the important events of the past ten months and to see to it that the Secretary has the name and address of any such persons. The Secretary until further notice will be at *5465 Greenwood Avenue, Chicago, Illinois*.